MIL-S-19500/155E(NAVY)
2 July 1974
SUPERSEDING
MIL-S-19500/155D(NAVY)
23 November 1973

MILITARY SPECIFICATION

# SEMICONDUCTOR DEVICE, DIODE, SILICON, POWER RECTIFIER, GENERAL PURPOSE

## TYPES 1N3189, 1N3190, 1N3191, TX AND NON-TX TYPES

This specification is approved for use by Naval Electronic Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the detail requirements for silicon, general purpose semiconductor diodes for use as power rectifiers in equipment circuits and is in accordance with MIL-S-19500, except as otherwise specified herein. The prefix "TX" is used on devices which have been submitted to and have passed the special process-conditioning, testing, and screening as specified in 4.4 through 4.4.5.3.

1.2 Physical dimensions. See figure 1.

1.3 Maximum ratings.

| Type | $V_R$ | $I_O$ $T_A$ = 150°C | $I_O$ $T_A$ = 100°C | $I_{FSM}$ 1/120 sec |
|---|---|---|---|---|
| | Vdc | Adc | Adc | A(pk) |
| 1N3189 | 200 | 0.5 | 1 | 30 |
| 1N3190 | 400 | 0.5 | 1 | 30 |
| 1N3191 | 600 | 0.5 | 1 | 30 |

OPERATING JUNCTION TEMPERATURE: -65° to +175°C

STORAGE AMBIENT TEMPERATURE: -65° to +175°C

## 2. APPLICABLE DOCUMENTS

2.1 The following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein:

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARDS

MILITARY

MIL-STD-202 - Test Methods for Electronic and Electrical Component Parts.
MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements for the diodes shall be in accordance with MIL-S-19500 and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500.

3.3 Design, construction, and physical dimensions. The diode shall be of the design, construction, and physical dimensions specified on figure 1.

3.3.1 Lead finish. Lead finish shall be gold plated or tinned. Lead finish may be specified in the contract or order (see 6.2) without affecting the qualified product status of the device or applicable JAN marking.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I and II (table III is applicable to "TX" types only).

3.4.1 Process-conditioning, testing, and screening for "TX" types. Process-conditioning, testing, and screening for the "TX" types shall be in accordance with MIL-S-19500 and as specified in 4.4.

3.5 Marking. The marking shall be as specified in MIL-S-19500 with the following exceptions:

(a) Manufacturer's identification, and country of origin may be omitted at the option of the manufacturer.
(b) "TX" devices (all): The type designation may be abbreviated by using the "JX" prefix in lieu of the "JANTX" prefix.

3.5.1 It is permissible to have the type designation on more than one line. Examples of acceptable marking are as follows:

| | | |
|---|---|---|
| JANIN<br>3189 | or | JXIN<br>3189 |

3.5.2 Polarity. The polarity shall be indicated by a diode graphic symbol with the arrow pointing toward the negative terminal for forward bias.

4. QUALITY ASSURANCE PROVISIONS

4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I and II. Group A inspection shall be performed on an inspection sublot of each type. Subgroups 1,2,3, and 4 of group B inspection may be performed on an inspection sublot of any type to qualify all types. Subgroup 5 of group B inspection shall be performed on the highest-voltage type within a barometric-pressure group to qualify that type and all lower-voltage types within the barometric-pressure group. Subgroups 6 and 7 of group B inspection shall be performed on an inspection sublot. Subgroups 8 and 9 of group B inspection shall be performed on an inspection sublot of the highest- and lowest-voltage types being qualified.

4.2.1 Instability. The device shall be swept through the reverse characteristic to the peak reverse voltage and the trace displayed on an oscilloscope. The device shall, at the same time, be subjected to shocks of 50 G's minimum at a minimum rate of 20 shocks per second for a minimum of 2 seconds or acceptable alternative. Any instability noted in the reverse trace shall be considered a failure.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of examinations and tests specified in groups A and B inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I. Group A inspection shall be conducted on an inspection sublot of each type.

4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II. Group B inspection may be done on a lot basis with the exception of subgroups 8 and 9. For subgroups 8 and 9, sublots of the highest-voltage types present in the lot shall be used to accept those types and all intermediate-voltage types.

4.4 Process-conditioning, testing, and screening for "TX" types. The procedure for process-conditioning, testing, and screening the "TX" types shall be in accordance with 4.4.1 through 4.4.5.3.

4.4.1 High-temperature storage. All devices shall be stored at least 48 hours at a minimum temperature (TA) of 175°C.

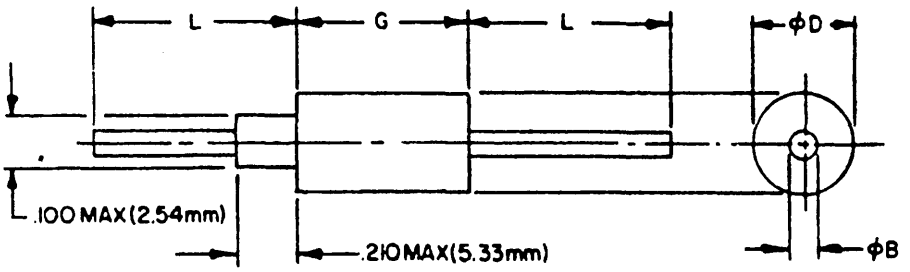
4.4.2 Thermal shock (temperature cycling). Thermal shock (temperature cycling) shall be performed in accordance with MIL-STD-750, method 1051, test condition C, except that 10 cycles shall be continuously performed and the time at the temperature extremes shall be 15 minutes, minimum.

4.4.3 Acceleration. All devices shall be subjected to an acceleration test in accordance with MIL-STD-750, method 2006, with the following exceptions: The test shall be performed one time in the $y_1$ orientation only at a peak level of 20,000 G minimum. The 1-minute hold-time requirement shall not apply.

4.4.4 Hermetic seal tests. All devices shall be subjected to hermetic seal tests (fine leak followed by gross leak).

4.4.4.1 Hermetic seal (fine-leak) test. All cavity devices shall be fine-leak tested in accordance with MIL-STD-750, method 1071, test condition G or H.

4.4.4.2 Hermetic seal (gross-leak) test (bubble). All devices shall be tested for gross leaks in accordance with MIL-STD-750, method 1071, test condition D, except that the solution may be any suitable noncorrosive liquid at a minimum temperature of 100°C.




| LTR | DIMENSIONS | | | |
|---|---|---|---|---|
| | INCHES | | MILIMETERS | |
| | MIN | MAX | MIN | MAX |
| ØB | .026 | .041 | .66 | 1.04 |
| ØD | .195 | .230 | 4.95 | 5.84 |
| G | | .350 | | 8.89 |
| L | 1.000 | | 25.40 | |

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Metric equivalents are in parentheses.
3. Cathode lead shall be electrically connected to the case. If tubulation is used, it shall be on the anode end.

FIGURE 1. Semiconductor device, diode 1N3189, 1N3190, 1N3191, TX, and non-TX types.

TABLE I. Group A inspection.

| Examination or test | MIL-STD-750 | | LTPD | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | Method | Details | Non-TX | TX | | Min | Max | |
| Subgroup 1 | | | 5 | 5 | | | | |
| Visual and mechanical | 2071 | | | | --- | --- | --- | --- |
| Subgroup 2 | | | 5 | 1 | | | | |
| Forward voltage | 4011 | $I_F$ = 750 mAdc | | | $V_F$ | --- | 1 | Vdc |
| Reverse current | 4016 | | | | | | | |
| 1N3189 | | $V_R$ = 200 Vdc | | | $I_R$ | --- | 5 | µAdc |
| 1N3190 | | $V_R$ = 400 Vdc | | | $I_R$ | --- | 5 | µAdc |
| 1N3191 | | $V_R$ = 600 Vdc | | | $I_R$ | --- | 5 | µAdc |
| Reverse current | 4016 | | | | | | | |
| 1N3189 | | $V_{RM}$ = 240 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| 1N3190 | | $V_{RM}$ = 480 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| 1N3191 | | $V_{RM}$ = 720 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| Instability | | See 4.2.1 | | | | | | |
| Subgroup 3 | | | 5 | 3 | | | | |
| High temperature operation | | $T_A$ = 150°C | | | --- | --- | --- | --- |
| Reverse current | 4016 | | | | | | | |
| 1N3189 | | $V_R$ = 200 Vdc | | | $I_R$ | --- | 500 | µAdc |
| 1N3190 | | $V_R$ = 400 Vdc | | | $I_R$ | --- | 500 | µAdc |
| 1N3191 | | $V_R$ = 600 Vdc | | | $I_R$ | --- | 500 | µAdc |

TABLE II. Group B inspection.

| Examination or test | MIL-STD-750 | | LTPD | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | Method | Details | Non-TX | TX | | Min | Max | |
| Subgroup 1 | | | 20 | 20 | | | | |
| Physical dimensions | 2066 | | | | --- | --- | --- | --- |
| Subgroup 2 | | | 15 | 10 | | | | |
| Solderability | 2026 | | | | --- | --- | --- | --- |
| Temperature cycling | 1051 | Test condition F1 | | | --- | --- | --- | --- |
| Thermal shock | 1056 | Test condition A | | | --- | --- | --- | --- |
| Moisture resistance | 1021 | | | | --- | --- | -- | --- |

TABLE II. Group B inspection - Continued.

| Examination or test | MIL-STD-750 | | LTPD | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | Method | Details | Non-TX | TX | | Min | Max | |
| Subgroup 2 - continued | | | | | | | | |
| End points: | | | | | | | | |
| Forward voltage | 4011 | $I_F$ = 750 mAdc | | | $V_F$ | --- | 1.0 | Vdc |
| Reverse current | 4016 | | | | | | | |
| 1N3189 | | $V_R$ = 200 Vdc | | | $I_R$ | --- | 5.0 | µAdc |
| 1N3190 | | $V_R$ = 400 Vdc | | | $I_R$ | --- | 5.0 | µAdc |
| 1N3191 | | $V_R$ = 600 Vdc | | | $I_R$ | --- | 5.0 | µAdc |
| Subgroup 3 | | | 15 | 10 | | | | |
| Shock | 2016 | Nonoperating; 1,500G, 5 shocks 0.5 ms 2 major axes | | | --- | --- | --- | --- |
| Constant acceleration | 2006 | 10,000G (non-operating) | | | --- | --- | --- | --- |
| Vibration, variable frequency | 2056 | Nonoperating | | | --- | --- | --- | --- |
| End points: (Same as subgroup 2) | | | | | | | | |
| Subgroup 4 | | | 15 | 10 | | | | |
| Terminal strength (lead fatigue) | 2036 | Test condition E | | | --- | --- | --- | --- |
| Subgroup 5 | | | 15 | 15 | | | | |
| Barometric pressure, reduced | 1001 | | | | | | | |
| 1N3189 | | $V_R$ = 200 Vdc | | | --- | --- | --- | --- |
| 1N3190 | | $V_R$ = 400 Vdc | | | --- | --- | --- | --- |
| 1N3191 | | $V_R$ = 600 Vdc | | | --- | --- | --- | --- |
| | | Altitude = 70,000 feet | | | | | | |
| Salt atmosphere | 1041 | | | | --- | --- | --- | --- |
| End points: (Same as subgroup 2) | | | | | | | | |

TABLE II. Group B inspection - Continued.

| Examination or test | MIL-STD-750 | | LTPD | | Symbol | Limits | | Unit |
|---|---|---|---|---|---|---|---|---|
| | Method | Details | Non-TX | TX | | Min | Max | |
| Subgroup 6 | | | 15 | 5 | | | | |
| Surge current | 4066 | $I_{FSM}$ = 30A(pk)<br>$I_F$ = 250 mAdc<br>5 surges,<br>1 surge/min | | | --- | --- | --- | --- |
| End points: (Same as subgroup 2) | | | | | | | | |
| Subgroup 7 | | | 15 | 15 | | | | |
| Peak reverse voltage | | $T_A$ = -65°C | | | | | | |
| 1N3189 | | $V_{RM}$ = 240 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| 1N3190 | | $V_{RM}$ = 480 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| 1N3191 | | $V_{RM}$ = 720 V(pk) | | | $I_{RM}$ | --- | 100 | µA(pk) |
| Subgroup 8 | | | λ=10 | λ=5 | | | | |
| Steady state operation life | 1026 | $I_O$ = 1.0 Adc<br>$T_A$ = 100° ±3°C | | | | | | |
| 1N3189 | | $V_R$(RMS) = 140 Vac | | | --- | --- | --- | --- |
| 1N3190 | | $V_R$(RMS) = 280 Vac | | | --- | --- | --- | --- |
| 1N3191 | | $V_R$(RMS) = 420 Vac | | | --- | --- | --- | --- |
| End points: | | | | | | | | |
| Forward voltage | 4011 | $I_F$ = 750 mAdc | | | $V_F$ | --- | 1.1 | Vdc |
| Reverse current | 4016 | | | | | | | |
| 1N3189 | | $V_R$ = 200 Vdc | | | $I_R$ | --- | 10.0 | µAdc |
| 1N3190 | | $V_R$ = 400 Vdc | | | $I_R$ | --- | 10.0 | µAdc |
| 1N3191 | | $V_R$ = 600 Vdc | | | $I_R$ | --- | 10.0 | µAdc |
| Subgroup 9 | | | λ=10 | λ=5 | | | | |
| High temperature life (non-operating) | 1031 | $T_A$ = 175° ±3°C | | | --- | --- | --- | --- |
| End points: (Same as subgroup 8) | | | | | | | | |

4.4.5 Preburn-in tests. The parameters $I_R$ and $V_F$ of table III shall be measured and the data shall be recorded for all devices in the lot. All devices shall be handled and identified such that the delta end points can be determined after the burn-in test. All devices which fail to meet these requirements initially shall be removed from the inspection lot and the quantity removed shall be noted on the permanent lot history.

TABLE III. Burn-in test measurements.

| Test | MIL-STD-750 Method | MIL-STD-750 Details ($T_A$ = 25° ±3°C) | Symbol | Limits Min | Limits Max | Unit |
|---|---|---|---|---|---|---|
| Reverse current | 4016 | 1N3189; $V_R$ = 200 Vdc | $I_R$ | --- | 5.0 | µAdc |
| | | 1N3190; $V_R$ = 400 Vdc | $I_R$ | --- | 5.0 | µAdc |
| | | 1N3191; $V_R$ = 600 Vdc | $I_R$ | --- | 5.0 | µAdc |
| Forward voltage | 4011 | $I_F$ = 750 mAdc | $V_F$ | --- | 1.0 | Vdc |

4.4.5.1 Burn-in test. All devices shall be operated for 96 hours minimum under the following conditions:

$T_A$ = 100°C minimum

$V_R$ = 140 Vac(rms) - 1N3189
280 Vac(rms) - 1N3190
420 Vac(rms) - 1N3191

$I_O$ = 1.0 Adc

4.4.5.2 Post-burn-in tests. The parameters $I_R$ and $V_F$ of table III shall be retested after burn-in and the data shall be recorded for all devices in the lot. The parameters measured shall not change during the burn-in test from initial value by more than the following amount:

$\Delta I_R$ = 100 percent or 2 µAdc, whichever is greater.

$\Delta V_F$ = ±0.025 Vdc.

4.4.5.3 Burn-in test failures. All devices that exceed the delta (Δ)limits of 4.4.5.2 or the limits of table III after burn-in shall be removed from the inspection lot and the quantity removed shall be noted on the permanent lot history. Where the quantity removed after burn-in exceeds 10 percent of the total inspection lot on burn-in test, the entire lot shall be unacceptable. Acceptable devices shall then be tested in accordance with the requirements of group A inspection (table I) and group B inspection (table II).

5. PREPARATION FOR DELIVERY

5.1 Preparation for delivery. Preparation for delivery shall be in accordance with MIL-S-19500.

6. NOTES

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Ordering data. Procurement documents should specify the following:

Lead finish if preference exists (see 3.3.1).

User activities:
Navy - AS, OS, MC, CG, SH

Preparing activity:
Navy - EC

Agent:
DSA - ES

(Project 5961-N599)